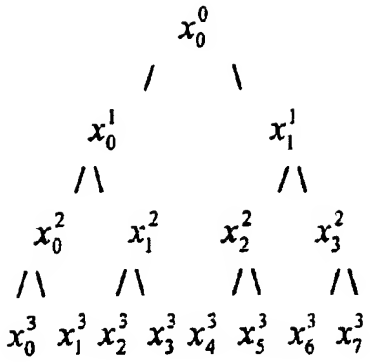

FIG. 1a

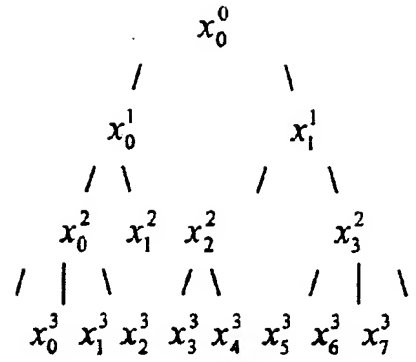

FIG. 1b

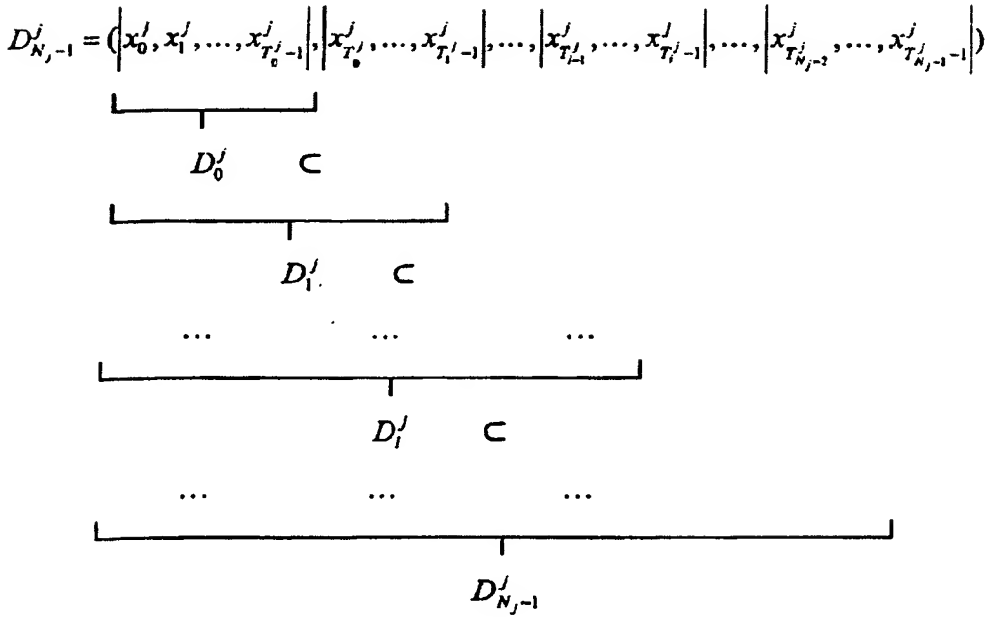

FIG. 3

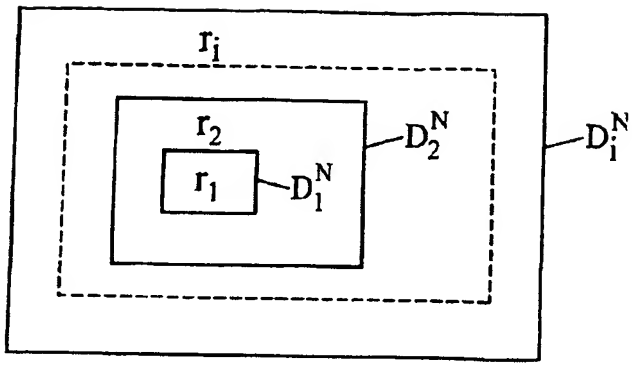
r_i
r_2
r_1
D_1^N
D_2^N
D_i^N

FIG. 2a

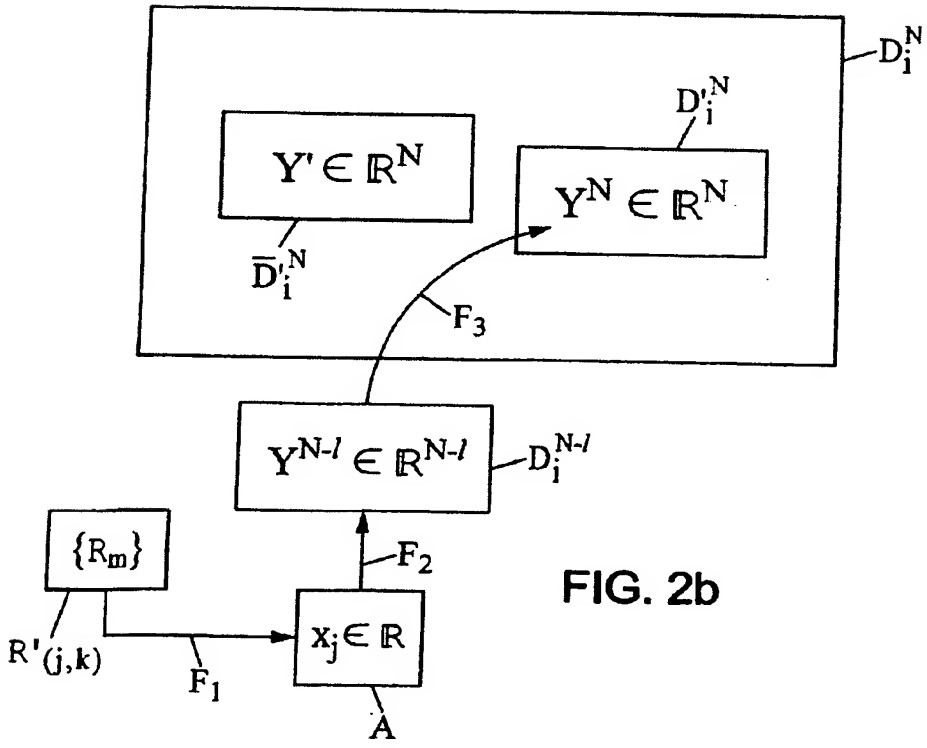
D_i^N
D'^N_i
$Y' \in \mathbb{R}^N$
$Y^N \in \mathbb{R}^N$
$\overline{D}'^N_i$
F_3
$Y^{N-1} \in \mathbb{R}^{N-1}$
D_i^{N-1}
$\{R_m\}$
F_2
$R'(j,k)$
$x_j \in \mathbb{R}$
F_1
A

FIG. 2b

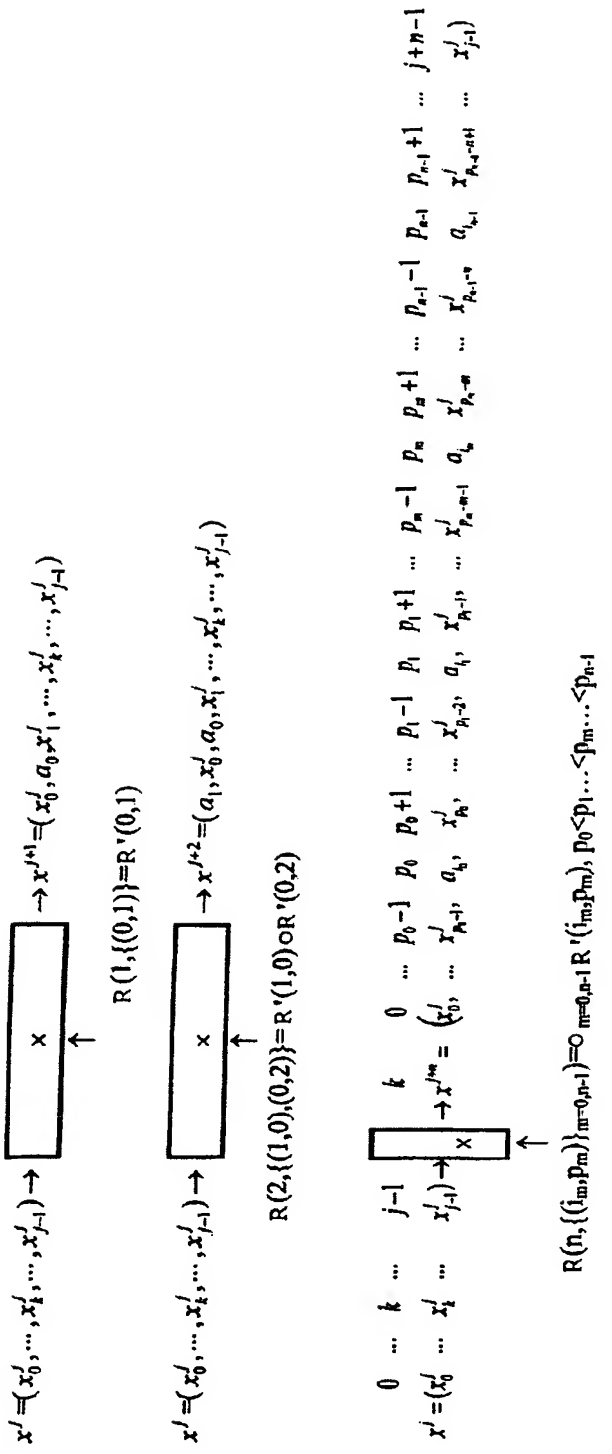
$x^j=(x_0^j,\cdots,x_k^j,\cdots,x_{j-1}^j)\rightarrow$
×
$\rightarrow x^{j+1}=(x_0^j,a_0,x_1^j,\cdots,x_k^j,\cdots,x_{j-1}^j)$
R(1,{(0,1)})=R'(0,1)
$x^j=(x_0^j,\cdots,x_k^j,\cdots,x_{j-1}^j)\rightarrow$
×
$\rightarrow x^{j+2}=(a_1,x_0^j,a_0,x_1^j,\cdots,x_k^j,\cdots,x_{j-1}^j)$
R(2,{(1,0),(0,2)})=R'(1,0)OR'(0,2)
$x^j=(x_0^j\ \cdots\ x_k^j\ \cdots\ x_{j-1}^j)\rightarrow$
×
$\rightarrow x^{j+m}=(x_0^j,\ \cdots\ x_{k-1}^j,\ a_k,\ x_k^j,\ \cdots\ x_{j-1}^j)$
0 … k … j−1 k 0 … p_0-1 p_0 p_0+1 … p_1-1 p_1 p_1+1 … p_n-1 p_n p_n+1 … $p_{n-1}-1$ p_{n-1} $p_{n-1}+1$ … $j+n-1$
$x^j=(x_0^j\ \cdots\ x_k^j\ \cdots\ x_{j-1}^j)\rightarrow x^{j+m}=(x_0^j,\ \cdots\ x_{k-1}^j,\ a_k,\ x_k^j,\ \cdots\ x_{k-2}^j,\ a_1,\ x_{k-1}^j,\ \cdots\ x_{k-n-1}^j\ a_0\ x_{k-m}^j\ \cdots\ x_{k-n-1}^j\ a_{k-1}\ x_{k-n+1}^j\ \cdots\ x_{j-1}^j)$
×
$R(n,\{(i_m,p_m)\}_{m=0,n-1})=\circ_{m=0,n-1}R'(i_m,p_m),\ p_0<p_1\ldots<p_m\ldots<p_{n-1}$

FIG. 4

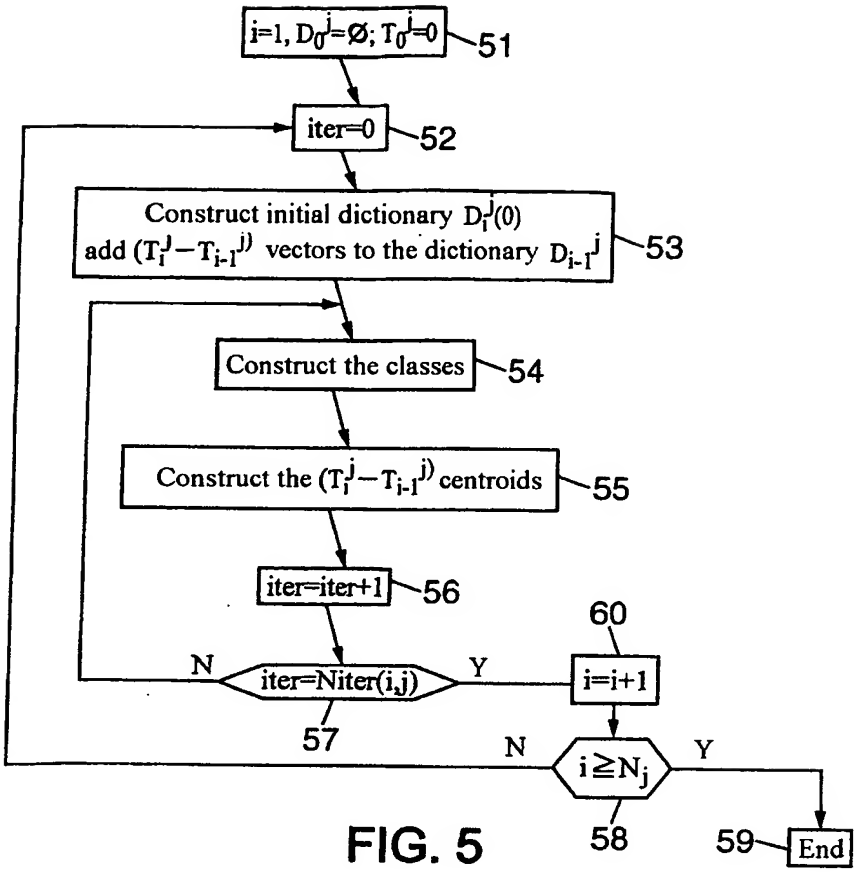
i=1, $D_0^j=\emptyset$; $T_0^j=0$
51
iter=0
52
Construct initial dictionary $D_i^j(0)$
add $(T_i^j-T_{i-1}^j)$ vectors to the dictionary D_{i-1}^j
53
Construct the classes
54
Construct the $(T_i^j-T_{i-1}^j)$ centroids
55
iter=iter+1
56
N
iter=Niter(i,j)
Y
57
60
i=i+1
N
$i \geq N_j$
Y
58
59
End

FIG. 5

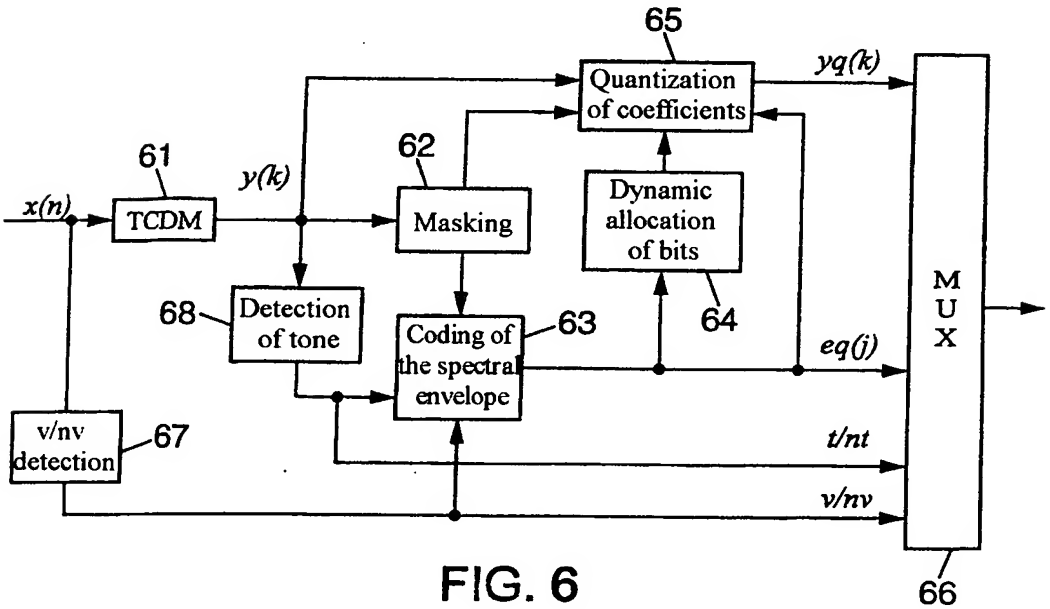
65
Quantization of coefficients
yq(k)
61
x(n)
TCDM
y(k)
62
Masking
Dynamic allocation of bits
64
68
Detection of tone
Coding of the spectral envelope
63
eq(j)
M
U
X
v/nv detection
67
t/nt
v/nv
66

FIG. 6

Band	Upper bound (Hz)	No. coefficients	Band	Upper bound (Hz)	No. coefficients
0	75	3	16	2375	10
1	150	3	17	2625	10
2	225	3	18	2875	10
3	300	3	19	3175	12
4	375	3	20	3475	12
5	475	4	21	3775	12
6	575	4	22	4075	12
7	675	4	23	4400	13
8	800	5	24	4725	13
9	925	5	25	5050	13
10	1050	5	26	5400	14
11	1225	7	27	5750	14
12	1425	8	28	6100	14
13	1650	9	29	6475	15
14	1875	9	30	6850	15
15	2125	10	31	7225	15

FIG. 7a

FIG. 7b

j	N_j	Rate per band $\{jr_0^j, jr_1^j, \ldots, jr_i^j, \ldots, jr_{N_j-1}^j\}$
1	1	1
2	5	2, 3, 4, 5, 6
3	8	3, 4, 5, 6, 7, 8, 9,10
4	10	3, 5, 6, 7, 8, 9,10,11,12,13
5	13	4, 6, 7, 8, 9,10,11,12,13,14,15,16,17
6	15	4, 7, 8, 9,10,11,12,13,14,15,16,17,18,19,20
7	18	4, 7, 8, 9,10,11,12,13,14,15,16,17,18,19,20,21,22,23
8	20	4, 7, 9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26
9	23	5, 8, 9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29
10	25	5, 8,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32
11	25	5, 8,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32
12	25	5, 9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32
13	25	5, 9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32
14	24	5, 9,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32
15	24	5, 9,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32

FIG. 7e

j	N_j	$\sum_{i=1}^{N_j} L_{D_i^j}$	$j\sum_{i=1}^{N_j} L_{D_i^j}$	$\sum_{k=1}^{j} k\sum_{i=1}^{N_k} L_{D_i^k}$	L_j	$\sum_{k=1}^{j} kL_k$	$\sum_{k=1}^{j} kL_k / \sum_{k=1}^{j} k\sum_{i=1}^{N_k} L_{D_i^k}$
1	1	1	1	1	1	1	1
2	5	18	36	37	6	13	0,351
3	8	71	213	250	16	61	0,244
4	10	166	664	914	27	169	0,185
5	13	418	2090	3004	48	409	0,136
6	15	695	4170	7174	48	697	0,097
7	18	1095	7665	14839	63	1138	0,077
8	20	1620	12960	27799	72	1714	0,062
9	23	2251	20259	48058	73	2371	0,049
10	25	3057	30570	78628	83	3201	0,041
11	25	2447	26917	105545	10	3311	0,031
12	25	2101	25212	130757	33	3707	0,028
13	25	1826	23738	154495	19	3954	0,026
14	24	1608	22512	177007	10	4094	0,023
15	24	1447	21705	198712	7	4199	0,021

j	N_j	$\sum_{i=1}^{N_j-1} L_{D_i^j}$	$j\sum_{i=1}^{N_j-1} L_{D_i^j}$	L_{D^j}	jL_{D^j}	$jL_{D^j} / j\sum_{i=1}^{N_j-1} L_{D_i^j}$
1	1	1	1	1	1	1.00
2	5	18	36	7	14	0.39
3	8	71	213	23	69	0.32
4	10	166	664	50	200	0.30
5	13	418	2090	98	490	0.23
6	15	695	4170	146	876	0.21
7	18	1095	7665	209	1463	0.19
8	20	1620	12960	281	2248	0.17
9	23	2251	20259	354	3186	0.16
10	25	3057	30570	437	4370	0.14
11	25	2447	26917	369	4059	0.15
12	25	2101	25212	321	3852	0.15
13	25	1826	23738	268	3484	0.15
14	24	1608	22512	233	3262	0.14
15	24	1447	21705	205	3075	0.14

FIG. 7c

j	L_{D^j}	$\sum_{k=1}^{j} L_{D^k}$	$\sum_{k=1}^{j} kL_{D^k}$	L_{Lj}	$\sum_{k=1}^{j} L_k$	$\sum_{k=1}^{j} kL_k$	$\sum_{k=1}^{j} kL_k / \sum_{k=1}^{j} kL_{D^k}$
1	1	1	1	1	1	1	1.00
2	7	8	15	6	7	13	0.87
3	23	31	84	16	23	61	0.73
4	50	81	284	27	50	169	0.60
5	98	179	774	48	98	409	0.53
6	146	325	1650	48	146	697	0.42
7	209	534	3113	63	209	1138	0.37
8	281	815	5361	72	281	1714	0.32
9	354	1169	8547	73	354	2371	0.28
10	437	1606	12917	83	437	3201	0.25
11	369	1975	16976	10	447	3311	0.20
12	321	2296	20828	33	480	3707	0.18
13	268	2564	24312	19	499	3954	0.16
14	233	2797	27574	10	509	4094	0.15
15	205	3002	30649	7	516	4199	0.14

FIG. 7d

l	j	l^j	Leader	l	j	l^j	Leader
0	1	0	1	12	3	5	4 1 1
1	2	0	1 1	13	3	6	4 4 1
2	2	1	2 1	14	3	7	5 1 1
3	2	2	3 1	15	3	8	6 1 1
4	2	3	4 1	16	3	9	3 2 1
5	2	4	5 1	17	3	10	4 2 1
6	2	5	9 1	18	3	11	4 3 1
7	3	0	1 1 1	19	3	12	5 2 1
8	3	1	2 1 1	20	3	13	5 4 1
9	3	2	2 2 1	21	3	14	7 3 1
10	3	3	3 1 1	22	3	15	8 2 1
11	3	4	3 3 1				

FIG. 7f

m^3	i	jr_i	leader x^3	j'	$x^{j'}$	l_m	m^3	i	jr_i	leader x^3	j'	$x^{j'}$	l_m
0	0	3	1 0 0	1	1	0	12	6	9	4 1 1	3	4 1 1	12
1	1	4	1 1 1	3	1 1 1	7	13	6	9	4 4 1	3	4 4 1	13
2	2	5	1 1 0	2	1 1	1	14	6	9	5 1 1	3	5 1 1	14
3	3	6	3 1 0	2	3 1	3	15	6	9	6 1 1	3	6 1 1	15
4	4	7	4 1 0	2	4 1	4	16	6	9	3 2 1	3	3 2 1	16
5	4	7	5 1 0	2	5 1	5	17	6	9	4 2 1	3	4 2 1	17
6	4	7	9 1 0	2	9 1	6	18	6	9	4 3 1	3	4 3 1	18
7	5	8	2 1 0	2	2 1	2	19	7	10	5 2 1	3	5 2 1	19
8	5	8	2 1 1	3	2 1 1	8	20	7	10	5 4 1	3	5 4 1	20
9	5	8	2 2 1	3	2 2 1	9	21	7	10	7 3 1	3	7 3 1	21
10	5	8	3 1 1	3	3 1 1	10	22	7	10	8 2 1	3	8 2 1	22
11	5	8	3 3 1	3	3 3 1	11							

FIG. 7g

Band	Upper bound (Hz)	No. coefficients	Band	Upper bound (Hz)	No. coefficients	Band	Upper bound (Hz)	No. coefficients
0	75	3	18	2875	10	35	8725	15
1	150	3	19	3175	12	36	9100	15
2	225	3	20	3475	12	37	9500	16
3	300	3	21	3775	12	38	9900	16
4	375	3	22	4075	12	39	10300	16
5	475	4	23	4400	13	40	10700	16
6	575	4	24	4725	13	41	11125	17
7	675	4	25	5050	13	42	11575	18
8	800	5	26	5400	14	43	12025	18
9	925	5	27	5750	14	44	12475	18
10	1050	5	28	6100	14	45	12925	18
11	1225	7	29	6475	15	46	13400	19
12	1425	8	30	6850	15	47	13900	20
13	1650	9	31	7225	15	48	14400	20
14	1875	9	32	7600	15	49	14900	20
15	2125	10	33	7975	15	50	15400	20
16	2375	10	34	8350	15	51	16000	24
17	2625	10						

FIG. 8a

j	N_j	$\{jr_0^j, jr_1^j, \ldots jr_i^j, \ldots jr_{N_j-1}^j\}$
1	1	1
2	5	2, 3, 4, 5, 6
3	8	3, 4, 5, 6, 7, 8, 9,10
4	10	3, 5, 6, 7, 8, 9,10,11,12,13
5	13	4, 6, 7, 8, 9,10,11,12,13,14,15,16,17
6	15	4, 7, 8, 9,10,11,12,13,14,15,16,17,18,19,20
7	18	4, 7, 8, 9,10,11,12,13,14,15,16,17,18,19,20,21,22,23
8	20	4, 7, 9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26
9	23	5, 8, 9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29
10	25	5, 8,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32
11	25	5, 8,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32
12	25	5, 9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32
13	25	5, 9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32
14	24	5, 9,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32
15	24	5, 9,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32
16	23	9,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,31
17	23	10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,31
18	23	10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,31
19	23	10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,31
20	23	10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,31
21	0	∅
22	0	∅
23	0	∅
24	24	9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,31

FIG. 8b